Abstracts

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T. TANAKA, M. NORIMOTO and M. YAMADA: **Dielectric Properties and Structure of Wood I,** Mokuzai Gakkaishi (J. Japan Wood Res. Soc.) **21**, 129 (1975). (in Japanese)

This paper dealt with the relationship between the dielectric properties and the grain angle of wood. The dielectric constant $\epsilon'(\theta)$ at a given grain angle θ was represented theoretically by the following equation.

$$\frac{1}{\epsilon'(\theta)}=\frac{\cos^2\theta}{\epsilon'_L}+\frac{\sin^2\theta}{\epsilon'_R}$$

where ϵ'_L and ϵ'_R are the dielectric constants in longitudinal and radial directions, respectively. The values calculated with this equation agreed well with experimental ones. The ratio of $\sqrt{\epsilon'_R}$ to $\sqrt{\epsilon'_L}$ increased with increasing temperature and with decreasing frequency. Moreover, from Cole-Cole's plots the parameters of the circular arc, $(\epsilon_0-\epsilon_\infty)$ and α, were determined; the value of the former decreased with θ but that of the latter did not change with θ.

M. NORIMOTO and T. YAMADA: **Dielectric Properties of Cellulose Irradiated with γ-Rays,** Mokuzai Gakkaishi (J. Japan Wood Res. Soc.) **21**, 151 (1975). (in Japanese)

The effects of gamma radiation from cobalt-60 on the dielectric properties of dry cellulose were investigated. Cole-Cole's circular arc law could be satisfactorily applied to the data obtained and the parameters of the circular arc, $(\epsilon_0-\epsilon_\infty)$ and β, were determined. Up to a dosage of 1×10^7 rad, no significant change in the value of these parameters took place. Irradiation to a dosage of 3×10^7 rad produced a slight increase in the value of $(\epsilon_0-\epsilon_\infty)$ but little change in the degree of crystallinity. This would suggest that the number of CH_2OH group contributing to the orientation increased mainly in the amorphous region. At irradiation levels excess of 3×10^7 rad definite reduction in the degree of crystallinity was observed. And the value of $(\epsilon_0-\epsilon_\infty)$ reached a maximum at around 1×10^8 rad, and this would suggest that the number of CH_2OH group constibuting to the orientation increased both in the amorphous and the crystalline regions. Irradiation above 1×10^8 rad induced a rapid decrease in the value of β, $(\epsilon_0-\epsilon_\infty)$ and the degree of crystallinity. This would suggest that the number of CH_2OH group decreased as a result of oxidization. On the other hand, by irradiation another dielectric relaxation process occurred in low frequency range at room temperature, and it was estimated that this process was probably due to the orientation of H_2O adsorbed to CHO and/or COOH groups.

M. NORIMOTO, T. TANAKA and T. YAMADA: **Dielectric Properties and Structure of Wood. II,** Mokuzai Gakkaishi (J. Japan Wood Res. Soc.) **21**, 342 (1975).

In this paper, the equations for dielectric constant of wood and cell wall are derived theoretically on the basis of the models illustrated in Figs 1 to 4 in which the fine structure of cell wall, the proportions of chemical constituents and the arrangement of cells are taken into account. The calculated values of dielectric constant for cell wall in oven-dried condition at 1 MHz and 20°C are 5.05 in the longitudinal direction and 4.42 (case I, see Eq. (2)) or 4.53 (case II, see Eq. (2′)) in the transverse direction, respectively, and are tabulated in Table 1 together with the results reported by the previous authors. The calculated values of dielectric constant for wood in three principal directions are presented as a function of specific gravity in Figs 8 and 9, and are compared with the experimental ones. The relationship of dielectric constant of wood to specific gravity is linear in the longitudinal direction and non-linear in the transverse direction. The anisotropy of dielectric constant for wood in the transverse direction can be expressed quantitatively by the value of q denoted in Fig. 3. The experimental values almost coincide with the theoretical curves.

T. TANAKA, M. NORIMOTO and T. YAMADA: **Anisotropy of Dielectric Constant of Wood**, J. Soc. Mater. Sci., Japan, **24**, 867 (1975). (in Japanese)

By taking account of the fine structures and the proportion and distribution of the chemical constituents, the values of dielectric constant for the tracheids in early and late woods as well as for the ray cell were theoretically calculated. Furthermore, by considering the fraction of cell wall and the arrangement of cells, the values of dielectric constant for early and late woods and those for wood in three principal directions were also calculated. From the results, it has been found that the anisotropy of dielectric constant of wood in the transverse direction depends on the fraction of late wood and the value of dielectric constant in the tangential pirection is influenced remarkably by the irregular arrangement of cells. The experimental values almost coincided with the theoretical ones.

M. NORIMOTO and T. YAMADA: **Dielectric Properties of Wood Irradiated with γ-Rays,** Mokuzai Gakkaishi (J. Japan Wood Res. Soc.) **21**, 645 (1975). (in Japanese)

Molecular structure changes in wood resulting from gamma irradiation are discussed from the result of measurements on dielectric properties, X-ray diffraction, infrared spectra and moisture regain. Up to about 3×10^6 rad no marked structure changes are detected. In the range 3×10^6 to 10^7 rad, the moisture-regain

value decreases, but little change in the dilelectric absorption is observed. In the range 10^7 to 10^8 rad, the moisture-regain value decreases, and this would suggest some alteration in the submicroscopic structure and the chemical structure from chain cleavage and carbonyl and carboxyl group formation. On the other hand, the dielectric absorption increases and this would indicate that the number of methylol group contributing to the reorientation increases in the crystalline region (increase of crystalline defects) as well as in the amorphous region contributing to water absorption. At dose levels greater than 10^8 rad, the moisture-regain value starts to rise again, whereas the dielectric absorption decreases rapidly. These would suggest that marked reduction of the crystalline region and oxidization of methylol group take place. Furthermore, the mechanism of an additional dielectric relaxation process occurred in low frequency range resulting from irradiation is discussed.

T. OHGAMA and T. YAMADA: **Relaxation Modulus of Wood as a Porous Material,** J. Soc. Mater. Sci., Japan, **24**, 873 (1975). (in Japanese)

The effect of the anatomical structure on the relaxation modulus of wood as a porous anisotropic material was discussed experimentally and theoretically through the numerical value of *form exponent n.*

Stress relaxation tests were carried out on a simplified model of the cell-lumen arrangement in the cross section of wood and the numerical values of n at 10, 10^2, 10^3 sec. were determined. On the basis of these experimental data, radial and tangential relaxation moduli were calculated by considering wood as a complex laminate with two stages of lamination, *i.e.* a laminate of alternating layers of transversely anisotropic earlywood and latewood perpendicular to ray tissue. In this paper, a "strength of materials' approach" was used in order to compute the relaxation modulus of the above complex laminate. Modulus of ray tissue was also calculated theoretically.

It was found that;

(1) The viscoelastic anisotropy of wood was strongly dependent upon the cell-lumen arrangement. However, in the viscoelastic analysis of whole wood, a unique complex lamination for wood must be taken into consideration in addition to cell geometry.

(2) As the numerical value of n was independent of time and the simplest mixture rule was applicable to estimate the modulus of wood, it might be considered that the relaxation process of wood was due to that of wood substance.

K. NISHIMOTO: **Trail-following Substances of Termite**, Kagaku (Chemistry), 2, 9 (1975). (in Japanese)

Trail-following substances of termite was reviewed and the relation between

the decayed wood and attractant was discussed.

K. NISHIMOTO: **Feeding Behavior and Foraging of Termite,** Kagaku To Seibutsu, **13**, 215 (1975). (in Japanese)

Feeding behavior of termite was explained in relation to food source and digestive process of wood.

M. TAKAHASHI: **Soft Rot on Wood,** Bokin Bobai (J. Antibact. Antifung. Agents), **3**(5), 9 (1975). (in Japanese)

The present status of the study on the soft rot is summarized, with special emphasis on recent contributions. Wood-decaying capacity, physiology and ecology of soft rot fungi are discussed in somewhat more detail. The importance of infections of soft rot fungi before the establishment of wood-decaying Basidiomycetes is emphasized.

K. NISHIMOTO and M. TAKAHASHI: **Deterioration of Wood and Microorganisms—Soft Rot,** Mokuzai Kogyo (Wood Industry), **30**, 500 (1975). (in Japanese)

Following a review of the cavity formation in lignified cell wall by soft rot fungi, the higher resistance of softwoods against soft rot and chemistry of soft-rotted wood are briefly discussed. In conclusion, the importance of soft rot in the biodeterioration of wood is emphasized, and soft rot fungi should be understood both as individuals and as part of an ecosystem including wood-decaying Basidiomycetes and other microorganisms.

T. ITOH: **Fine Structure of the Plasmalemma Surface of Poplar Parenchyma Cells Observed by the Freeze Etching Technique,** Bot. Mag. Tokyo **88**, 131 (1975).

The plasmalemma surface of poplar parenchyma cells observed by the freeze etching technique is characterized by 11 nm particles, primary pit fields, lomasome-like structures and fibrillar structures.

The most remarkable feature is the occurrence of fibrillar structures, which are considered to be the imprint of underlying microtubules on the plasmalemma surface. The previously reported observation on the possible appearance of microtubules at the cytoplasmic surface inside the plasmalemma is questionable.

Afthough the fibrillar structures run almost perpendicular to the main cell axis, longitudinally oriented ones are also found, the occurrence of which is discussed in relation to the orientation of the cellulose microfibrils.

T. ITOH: **Cell Wall Organization of Cortical Parenchyma of Angiosperms Observed by the Freeze Etching Technique,** Bot. Mag. Tokyo **88**, 145 (1975).

Cell wall organization of the parenchyma in the primary tissue of 3 angiosperms of *Populus nigra* var. *italica* Koehne, *Morus bombycis* Koidz. and *Phaseolus vulgaris* var. *humilis* Alef. was investigated by the freeze etching technique.

The walls of these parenchyma cells have a crossed polylamellate structure, although a variety of fibrillar angles are found between 2 lamellae adjacent to one another.

On the basis of this evidence, this paper discusses whether the growth of parenchyma cell walls can be interpreted by a simple multinet growth hypothesis.

A. ENOKI and K. KITAO: **Autoxidation of Resin Acids. III. Photooxidation of Abietic Acid,** Mokuzai Gakkaishi, **21**, 101 (1975).

The autoxidation of methyl abietate (I) was studied under irradiation with sun light in the air. From the reaction products five *n*-hexane-soluble products were isolated and identified as methyl 7-oxo-dehydroabietate (II), methyl 7α-hydroxydehydroabietate (III), 7α-hydroxy-8α, 9α; 13α, 14α-diepoxide (IV), peroxide (V), and methyl 13α, 14α-epoxy-$\Delta^{7(8)}$-dihydroabietate (VI) respectively. Products (II), (III), (IV), were considered to be formed through methyl 7α-hydroperoxypalustrate (X) from the analogy of the results in the nonsensitized photooxidation of methyl palustrate and methyl levopimarate. Along with hexane-soluble products, hexane-soluble products, hexane-insoluble product was obtained which was probably a complex mixture having a fairly large amount of oxygen and was not further studied.

H. SASAKI, S. TAKINO, Y. UCHIDA, H. KANEDA, M. MASUDA and T. MAKU: **Testing Method of Rigidity and Strength for Durability Test of Wood-based Bearing Wall Panels**, J. Soc Mater. Sci. Japan **24**, 890 (1975). (in Japanese)

Simple test method of rigidity and horizontal shear strength utilizing the diagonal compression of two square panels with frames on the edges has been established. The rigidity and strength of five kinds of nail-glued wood-based panels measured by this method are 1.5 to 3 times larger than those by the traditional racking test method without the hold-down ties. Numerical analysis of stress distribution in the specimens of these two method was done using finite element method. The result showed that the differences in strengths and rigidities observed in these two methods were interpreted as being caused by the high stress concentration in the racking test specimen.

H. KANEDA and T. MAKU: **Studies on the Weatherability of Composite Wood III. Decrease of Strength and Bonding Properties of Exterior and Constructive Plywood by Exterior Exposure**, Mokuzai Gakkaishi (J. Japan Wood Res. Soc.), **21**, 596 (1975). (in Japanese)

Lauan exterior and constructive plywoods were tested by exposure to the wea-

ther for three or four years. Two kinds of plywoods were used; one was 7.7 mm thickness plywood of three layers with phenolic-resin adhesive, and the other was 12 mm thickness plywood of five layers with phenolic-resin adhesive and melamine-urea resin adhesive. A half of 7.7 mm thickness plywood was painted with acrylic-resin paint. After exposure, plywoods were tested to determine deterioration of bending and bonding strength.

H. KANEDA and T. MAKU: **Studies on the Weatherability of Composite Wood IV. Application to the Estimation of Bonding Property of Exterior Exposure Plywood by Delamination Test Perpendicular to Plywood Surface in ASTM Standards**, Mokuzai Gakkaishi (J. Japan Wood Res. Soc.), **21**, 604 (1975). (in Japanese)

On the decrease of bonding property of exterior and constructive plywood by exterior exposure, delamination test perpendicular to plywood surface of ASTM-D1037-60T was done in comparison with glue joint shear strength test. Two kinds of plywoods were used. One was 7.7 mm thickness plywood of three layers with phenol resin adhesive, the other was 12 mm thickness plywood of five layers with phenol resin adhesive and melamine-urea resin adhesive. A half of 7.7 mm thickness plywood was painted with acrylic resin paint.

M. MASUDA and T. MAKU: **Analysis of Buckling of the Plywood with the Distribution of the Elastic Constants and the Initial Imperfection. I. —Fundamental Equation and the Method of Numerical Analysis,** Mokuzai Gakkaishi (J. Japan Wood Res. Soc.), **21**, 123 (1975). (in Japanese)

Typical buckling does not occur when plywood has initial imperfections, however, plywood has more or less initial deflection (geometrical imperfection) and the distribution of Young's moduli. To make clear the real buckling behavior, the author developed the fundamental equations for the analysis of the finite (or large) deformation of the plywood with the imperfections. And the comuter program was made to solve these equations by means of the nonlinear finite difference method.

M. MASUDA and T. MAKU: **Analysis of Buckling of the plywood with the Distribution of the Elastic Constants and the Initial Imperfection. II —Accuracy of the Solution, and the Influence of Initial Imperfection and Weak Parts**, Mokuzai Gakkaishi (J. Japan Wood Res. Soc.), **21**, 493 (1975). (in Japanese)

The accuracy of the solutions and the method of extrapolation of the exact solution are discussed in the first part of this paper. And then the influence of the initial deflection is shown with figures, which indicate that the typical buckling

behavior is not observed even if the initial deflection is only 1/10 of the thickness. The face grain angle (0°, 45°, −45° and 90°) has the significant effects on the buckling behavior both in compression and in shear. And the existence of the weak part has the direct effect on the buckling load.

M. MASUDA and T. MAKU: **Influences of the Imperfection of Lamination, the Loading Condition and the Supporting Condition on the Buckling Behavior of Plywood,** J. Soc. Mater. Sci, Japan, **24**, 897 (1975). (in Japanese)

The influences of the eccentric load and the unsymmetric lamination on the load-deflection curve (buckling) of the plywood and the effect of the combination of the different imperfections were investigated by means of the numerical analysis. And it became clear that the typical buckling occurs only in the special cases; (i) perfect plywood and perfect loading, and (ii) counterbalance of the different imperfections. The influence of the initial compression on the L-D curve of the plywood in shear, the effect of the combination of clamped and simply supported edges and the effect of the intermediate edge condition of the "simply" and the "clamp" were also observed.

K. KOMATSU : **Fracture of Adhesive Joints of Wood and Fracture Mechanics**, Setschaku (Adhesion & Adhesives), **19**, 315 and 352 (1975). (in Japanese)

First, the Griffith-Irwin fracture theory and its application to the fracture problem of adhesive joint system was introduced briefly. Then, the compliance method and the J-integral method for estimating the fracture toughness G_C of wood adhesive joint systems were explained with a few examples. Finally, a preliminary attempt of predicting fracture load in double lap joint specimen by applying the J-integral method was shown. Theoretical and experimental discussions were done in the effects of geometries of specimen on the fracture load.

T. HIGUCHI, F. NAKATSUBO and Y. IKEDA: **Enzymic Formation of Arylglycerols from *p*-Hydroxycinnamyl Alcohols**, Holzforschung, **28**, 189 (1974).

Guaiacyl-, syringyl- and *p*-hydroxyphenylglycerols were isolated from the enzymic dehydrogenation products of the corresponding *p*-hydroxycinnamyl alcohols and identified. These arylglycerols were a mixture of *threo* and *erythro* isomers and the amount of the former was 1 — 4 times higher than that of the latter. Possible occurrence of free aryglycerol side chains in lignin molecules were discussed.

F. NAKATSUBO and T. HIGUCHI: **Enzymic Dehydrogenation of *p*-Coumaryl Alcohol I. Structure of Dimeric Compounds,** Holzforschung, **29**, 64 (1975).

p-Coumaryl alcohol (1) was dehydrogenated with peroxidase and H_2O_2. Four dimeric compounds, *p*-coumarylresinol (2), dehydrodi-*p*-coumaryl alcohol (3), *p*-

hydroxyphenylglycerol-β-*p*-coumaryl ether (4), and 2-(4-hydroxyphenyl)-3-hydroxymethyl-4-(α, 4-dihydroxybenzyl)-tetrahydrofuran [monoepoxylignan (5)] were isolated and identified. The nonequivalency and assignment of the γ-methylene protons of these dimeric compounds on the NMR spectra were discussed and their configurations were determined. The compound (4) was obtained as mainly *threo* form which contained a small amount of *erythro* isomer. Cβ- and Cβ'-protons of the tetrahydrofuran rings of (2) and (5) were determined to be *cis* and *trans* configurations respectively and their possible formation by racemoid and mesoid couplings in the enzymic dehydrogenation were discussed.

F. NAKATSUBO and T. HIGUCHI: **Enzymic Dehydrogenation of *p*-Coumaryl Alcohol II. Configuration of Phenylcoumaranes,** Holzforschung, **29**, 95 (1975).

Dehydrodiconiferyl alcohol (2) was reduced with H_2/Pd-carbon and the reduced product was methylated with diazomethane. The methylated product was then sulfonated with benzene sulfonyl chloride and the product was reduced with lithium aluminum hydride to γ,γ'-methyl derivative (4b), the structure of which was the same to dihydrodehydrodiisoeugenol methyl ether (4a). By comparison of the spectral data of both compounds, the configuration of dehydrodiconiferyl alcohol (2) was determined to be *trans*. Furthermore, γ,γ-methyl derivative (4c) of dehydrodi-*p*-coumaryl alcohol (3) was synthesized by the same method used in the case of (2). On the NMR spectrum, the chemical shifts and coupling constants of the protons of the side chain of (4c) were almost identical with those of (4a). These results indicated that the configuration of dehydrodi-*p*-coumaryl alcohol (3) was *trans*.

F. NAKATSUBO, K. SATO and T. HIGUCHI: **Synthesis of Guaiacylglycerol-β-guaiacyl Ether**, Holzforschung, **29**, 165 (1975).

Guaiacylglycerol-β-guaiacyl ether (1), the model compound of arylglycerol-β-aryl ether structure in lignin was synthesized in high yield through five reaction steps from vanillin. The key step of this synthetic method was the condensation reaction between ethyl 2-methyxyphenoxy acetate (4) and benzyl vanillin (5). At this step, lithium diisopropyl amide was used as the base, and β-hydroxy ester (6) was obtained in 95 % yield as an oily substance consisted of two isomers, from which only *erythro* isomer was obtained as crystal in 51 % yield. The residual oily substance was converted to its carbamate (7) and crystallized in 70 % yield. The crystalline α-hydroxy ester (6) and the carbamate (7) were then converted to the final compound (1) by the lithium aluminum hydride reduction and subsequent hydrogenation with Pd-C. The overall yield of the guaiacylglycerol-β-guaiacyl ether (1) from benzyl vanillin (5) was about 72 %.

T. HIGUCHI: **Biosynthesis of Lignin,** Kagaku to Seibutsu, **13**, 206 (1975).

(in Japanese)

Biosynthesis of lignin was reviewed in relation to plant evolution.

T. HIGUSHI : **Biosynthesis of Cell Wall Components of Wood and Organelles concerned**, J. Soc. Mater. Sci., Japan, **24**, 798 (1975). (in Japanese)

Biosynthesis of cellulose, hemicellulose and lignin was reviewed and discussed in relation to the organelles concerned.

H. KURODA, M. SHIMADA and T. HIGUCHI; **Purification and Properties of *O*-methyltransferase involved in the Biosynthesis of Gymnosperm Lignin**, Phytochem., **14**, 1759 (1975).

An O-methyltransferase which catalyzes the formation of the methoxyl groups of guaiacyl lignin was extracted from Japanese black pine seedlings. The enzyme was purified 90-fold by ammonium sulfate precipitation, and by chromatography on DEAE-cellulose and Sephadex G100. The enzyme preparation mainly catalyzed the methylation of caffeic acid to give ferulic acid, although the methylation of 5-hydroxyferulic acid to sinapic acid, which was competitively inhibited by caffeic acid, was slightly catalyzed. The V_{max} for caffeic acid was 25 times higher than that for 5-hydroxyferulic acid, and the corresponding K_m values were 5.11×10^{-5} and 2.77×10^{-4} M, respectively. The provisional MW of the enzyme was estimated to be 6.7×10^4 by gel filtration chromatography. Magnesium ions were not an absolute requirement but increased enzymic activity. These results explain the preponderance of guaiacyl units in conifer lignin.